DOCUMENT RESUME

ED 123 720 EA 008 271

AUTHOR Chambers, Jay G.
TITLE Educational Price Differentials: A Clarification of the Issues.
PUB DATE Mar 76
NOTE 36p.; Speech presented at the Annual American Educational Finance Conference (19th, Nashville, Tennessee, March 14-16, 1976)

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS *Cost Indexes; *Educational Finance; Educational Technology; Elementary Secondary Education; *Equalization Aid; Mathematical Models; Resource Allocations; Statistical Analysis; *Teacher Salaries

ABSTRACT

This paper provides a clarification of two factors--the differences in pupil need (as reflected by the proportion of disadvantaged or handicapped pupils in a district) and the differences in the prices of school inputs across districts--that affects the cost of educational services and a conceptual framework that may be useful in making welfare comparisons across school districts. Section 1 provides a clarification of what is meant by the concept of an educational price differential. Section 2 deals with the impact of wealth disparities on the demand for educational quality and reveals the extent to which variations in the demand for educational quality lead to salary differentials for school personnel. Section 3 examines the sources and nature of the variations in the cost of educational services. Section 4 presents a discussion of the economic theory of index numbers along with some of the problems encountered in the determination of the "true" cost-of-education index. Finally, section 5 clarifies what is required in order to calculate a cost index for educational services. (Author/IRT)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED123720

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

EDUCATIONAL PRICE DIFFERENTIALS:

A CLARIFICATION OF THE ISSUES

by

Jay G. Chambers*

This paper was prepared for presentation at the American Educational Finance Conference in Nashville, March 1976.

*The author is an Assistant Professor of Education and Management (Economics) at the University of Rochester. The author wishes to express his thanks to Walter Garms for initially stimulating the author's interest in the topic of cost indices in education and Guilbert Hentschke for helpful comments on a draft of this paper. Any remaining errors are, of course, the responsibility of the author.

EA 008 271

There has been much discussion in recent years regarding the implementation of various school finance reforms. At the center of much of the debate is the issue of equity in the financing of educational services. Specifically, this involves the determination of methods by which policy makers can equalize the distribution of funds to reduce or eliminate entirely the differences in the quality of educational services attributed to disparities in wealth across local school districts.[1] In effect this effort at equalization means devising state school aid formulas that would make local school district expenditures per pupil independent of the wealth of the local community.[2] By whatever method wealth neutrality is established, it is clear that there are two other factors relevant to school finance reform and the equity issue that must be accounted for, and that, to some extent, these factors may modify the goal of wealth neutrality as a method of establishing an equitible school finance system. These two factors are (1) the differences in pupil-need (as reflected by the proportion of disadvantaged or handicapped pupils in a district) and (2) the differences in the prices of school inputs across districts.

It is the purpose of this paper to provide a clarification of how these two factors affect the cost of educational services and to provide a conceptual framework which may be useful in making welfare comparisons across school districts. Section I provides a clarification of what is meant by the concept of an educational price differential. Section II deals with the impact of wealth disparities on the demand for educational quality and reveals the extent to which variations in the demand for educational quality lead to salary differentials for school personnel. The purpose of this analysis is to demonstrate that to some degree the observed differences in the salaries of school personnel are a matter of choice (i.e., endogenous) to school decision-makers in that they reflect attempts to attract better quality personnel. In Section II the sources and nature of the variations in the cost of educational services are examined: specifically, those factors which are not a matter of choice but rather are outside the control of (i.e., exogenous to)

school decision-makers. These exogenous factors involve the differences in both pupil-need and the supply of school inputs across local school districts. Section IV presents a discussion of the economic theory of index numbers along with some of the problems encountered in the determination of the "true" cost-of-education index. Finally, Section V wraps up this discussion by clarifying what is required in order to calculate a cost index for educational services.

II. Educational Price Differentials

Variation in educational expenditures are composed of essentially two elements: (1) variation in the amount of educational services purchased and (2) variation in the price of those educational services. To formalize this conceptualization, let the level of educational expenditures per pupil be denoted by the symbol E, the level of quality of educational services per pupil be denoted by Q (i.e., Q represents the amount of educational services purchased), and the price of a unit of educational quality be denoted by P. Formally, this relationship may be then be written as[3]/

$$E = P \cdot Q. \qquad (1)$$

There are four sets of factors that influence the demand for educational quality (Q). These factors are the same basic elements that go into the determination of the variation of consumer demand. Specifically, the amount of educational services purchased (i.e., demanded) by a given school district is a function of the relative price of educational services (i.e., the price of educational services relative to the prices of all other consumer goods and services), the fiscal capacity of the school district (i.e., local fiscal capacity along with the level of intergovernmental grants-in-aid from state and federal sources), the factors affecting the local tax burden (e.g., the composition of the local tax base with

regard to residential versus business property), and the taste for educational services of the local constituency.[4] Presumably, holding all else equal, the higher the relative price of educational services the less will be consumed (i.e., the demand curve for educational quality is negatively sloped) and the communities with greater fiscal capacity will purchase greater amounts of educational quality.

There are two sets of factors that influence the variation in the price (or cost), P, of educational services: (1) those factors that affect the supply, and therefore the prices, of school inputs (e.g., the quantity and quality of teachers' services) and (2) those factors which affect the technology of the educational production process (e.g., the scale of operation and the nature of pupil-needs).

The elements which compose the demand for educational quality (Q) and the determination of educational costs (P) are elaborated upon below.

II. Wealth Disparity, Demand for Educational Quality, and Salary Differentials of School Personnel.

It has been generally observed that wealthy school districts outbid poorer districts in the market for various school inputs. In this regard one might ask whether more of these school inputs necessarily means better quality educational services. There are two issues implicit in dealing with this question. The first question is what do we mean by quality. The second question concerns what we mean by wealth disparity or perhaps differences in fiscal capacity. Let us consider each of these questions in turn.

Ideally, one would like to have some universally accepted concept of educational quality which would allow for comparisons of the level of educational services across school districts. But who is to define this universal concept of quality: cental (state) policy-makers, researchers, etc.? Even if we could define what the appropriate outcomes should be, how would we measure them and

moreover, how would we assess their relative importance in order to combine them into an overall quality index? Given the primitive state of the art revealed in studies of the educational production process, it is only too obvious that educational quality and technology cannot at this point in time be measured or assessed in any precise manner.

With this problem of measurement in mind, one might employ a concept analogous to consumer sovereignty to resolve the issue of what we mean by educational quality. The concept of consumer sovereignty implies that the wants of the society are expressed in the market. That is, the consumer not as an individual but as a collective force in the market determines the pattern of economic activity. If consumers do not desire a particular good or service, or are unwilling to purchase it at the offered price, that good or service will go unsold. Applied to the market for school inputs, this analysis suggests that we rely upon the judgements, as revealed through market behavior, of local school decision-makers (i.e., those who represent the consumers of educational services) regarding which school inputs do or do not contribute to educational quality. For the purpose of analyzing variations in the cost of educational services, why should researchers or educational policy-makers, who are in general a considerable distance from the ongoing process of education, make arbitrary judgements as to what does or does not constitute school quality? Local decision-makers (i.e., school boards and school administrators) are not only closest to the actual production process, but also are more directly responsible for reflecting the perceptions and preferences of local constituencies with regard to educational priorities.

Based on these considerations, it would seem appropriate to rely on the perceptions of those who have been given the responsibility by local citizens to make decisions about educational quality. If one accepts this premise, then a

market test can be devised which will reveal which school inputs (e.g., which characteristics of teachers) are perceived by local decision-makers to contribute to educational quality.[5] The use of such a methodology relieves the researcher or the state policy-maker from having to make judgements regarding this issue and places the issue in the hands of those perhaps most capable of providing a reasonable and credible assessment of what factors affect or contribute to school quality. The empirical methodology involves the determination of which educational inputs are endogenous (i.e., a matter of choice) to school decision-makers. For example, for which teacher characteristics are school officials willing to pay a price on the market and does the level of employment respond to changes in prices and school budgets? If school districts do not desire to purchase a particular teacher characteristic (i.e., because it is not perceived as contributing to educational quality), then that characteristic will not bring forth a price in the market for teachers. Furthermore, for those characteristics which are desired by school districts, the level of employment of that characteristic will respond systematically to price and budget changes and an implicit market price will be revealed.

This empirical methodology is based on a theoretical structure which is elaborated upon in Antos and Rosen (1974). Labor market transactions involve a mutual exchange of labors' productive attributes and the attributes of the work place that define working conditions. To quote Antos and Rosen:

> Teachers sell the services of their labor, but simultaneously purchase utility bearing characteristics of the schools in which they work. On the other side of the bargain, school administrators purchase desired teachers services and jointly sell characteristics of schools and students to their teachers. Every contract quotes a price for the total package of labor services and on-the-job consumption, and the content of the package varies from school to school. Hence, comparisons of wage rates across teacher characteristics and consumption attributes yield a functional relationship from which it is sometimes

> possible to impute prices for various dimensions of the underlying exchange package. The observed relation between salaries, teacher characteristics and school characteristics is determined by the market.....(p. 1)

Let us now address the second question of what we mean by fiscal capacity and of how we measure differences across school districts. The issues related to what the relevant measures of fiscal capacity are (or should be) are well known.[6] The relevant consideration in the determination of what should be used as a measure of a district's fiscal capacity relates to those factors which affect the relative burden of taxes placed upon local taxpayers to provide a given level of educational services. In this context, it is suggested that income per taxpaying household is the relevant determinant of the ability of local residents to undertake a given burden of school property taxes. That is, property value (which forms the local tax base for school taxes) is not a good measure of fiscal capacity since it may be only weakly related to the ability and/or willingness of local residents to tax themselves for educational services.[7]

Using family income as a measure of fiscal capacity, we may now examine the extent of difference in the quality of educational services being delivered to various school districts. These differences will be measured in terms of the differences in the service levels of school inputs as suggested by the market test approach outlined above.

Table I presents some empirical estimates of the differences in school spending per pupil, the salaries of the school personnel, and the demand for the quantity and quality of teachers services attributed to differences in the levels of community income (in column 2) and the state and federal grants-in-aid (in column 3). The estimates are based on a study of resource allocation on a sample of California elementary school districts for the 1970-71 school year.[8] For the purposes of this example, the difference between high and low income districts is

Table I about here

set at $4,000 per household which is approximately equal to the difference between plus and minus one standard deviations for the sample of elementary districts. The empirical results indicate that, ceteris paribus, districts with higher levels of income per household or larger grants per pupil will tend to spend more on educational services, pay higher salaries to school personnel, and employ greater quantities of school inputs per pupil.

Because of the manner in which state, and to some extent federal, grants are distributed, there is an inverse relations between the level of community income and grants-in-aid across school districts: higher income communities generally receive smaller per pupil grants.[9/] One of the objectives of providing school districts with state and federal grants-in-aid is to equalize educational opportunities across districts by compensating for the existing disparities in fiscal capacity which would otherwise lead to differences in the quality of educational services supplied to children from different socioeconomic backgrounds. The estimates indicate that for each $1,000 of community income per household, the average elementary district gives up $18.02 in grants-in-aid per pupil. If the net result of this trade-off between income and grants-in-aid leads to an increase (decrease) in the level of expenditures per pupil, the salaries of school personnel, and the demand for the quantity and quality of teachers services, then it suggests that the distribution of grants-in-aid does not (does) compensate districts for differences in community income. The net differences in resource allocation are reported in column 4.

Even with the lower level of outside grants, the higher income districts still spend more on educational services, pay higher salaries, which presumably attract better quality school personnel, and maintain smaller classes. The increased quality of school personnel refers not only to the traditional experience and educational preparation, but also to other teacher characteristics (such as teacher verbal

ability) which are not explicitly accounted for in district salary schedules. These other teacher characteristics are likely to be accounted for in district policies in setting starting salaries, ceteris paribus. For example, using the estimates of the differential in starting teachers' salaries from Table I along with Levin's (1968) estimates of the implicit market price of teachers verbal ability, the high income district could purchase close to eight additional units of teacher verbal ability with the net difference that they are willing to pay. The implication of this analysis is that the reason wealthier districts pay higher salaries is because they perceive some additional benefit in terms of their ability to attract what they view as better quality school personnel.

III. Cost of Education, Salary Differentials for School Personnel, and Variation in the Educational Technology.

There are two sets of factors which lead to variations in the cost of producing a given quality of educational services: those factors affecting (1) the supply of school inputs and (2) the technology of educational production. The salaries of school personnel are the most important source of variation in the cost of educational services attributed to supply factors. The sets of factors which determine personnel salaries (denoted below by the vector S) may be divided into two parts: (i) those factors which are endogenous to school decision-making (i.e., the demand factors) such as the choice of personnel quality characteristics (denoted by the vector q which includes experience, educational preparation, and other relevant ability characteristics such as teacher verbal facility) and working conditions (denoted by the vector W which includes, e.g., class size) and (ii) those factors which are exogenous to school decision-making (i.e., the supply factors denoted by the vector Z_S) which reflect the relative attractiveness of employment in a given district (e.g., district size, racial and ethnic composition of the pupils, and local labor market conditions). Formally, this salary equation,

the parameters of which are determined in the markets for various school personnel, may be expressed as

$$S = s(q, W, Z_S). \qquad (2)$$

In the jargon of the economist, this salary equation (2) is referred to as the market price schedule for school personnel. The parameters (i.e., estimated regression coefficients) of this market price schedule convey to school decision-makers the increment of salary which must be paid in the market for each of the attributes contained in the vectors (q, W, Z_S). These increments must be reflected either explicitly (as would those paid for experience and education) or implicitly (as would those paid for such attributes as teacher verbal ability or district characteristics such as racial composition of pupils) in district salary schedules. For exmaple, Levin (1968) reports that the implicit market price for an additional unit of teacher verbal ability is around $24 while the market price for an additional year of schooling for teachers ia approximately $500. Similarly, Antos and Rosen report that school districts which enroll black students must pay, on the average, a positive salary differential of $5 to $7 for every percentage point of black students in order to attract a given quality of teachers' services.

It is in fact the differentials in the salaries of school personnel attributed to the supply factors which are of concern in the determination of variation in the costs of educational services. As suggested above these supply factors are exogenous to (i.e., outside the control of) school decision-makers. This implies that the value of a dollar's worth of state aid varies across school districts depending upon the conditions which determine the local supply of school inputs. As is indicated in the analysis of wealth disparities above, it is once again necessary to determine what we mean by educational quality.

Some of the previous attempts at constructing an education cost index make

arbitrary assumptions about which characteristics of school personnel should be held constant in order to construct a cost index.[10] In effect the question that each of these studies must address is, "Which teacher characteristics affect the quality of school service?" For example, the NEA and Woollatt indices assume that teachers' education and experience are related to quality throughout the full range of these variables, while the New York State Education Department Index assumes that educational quality is unrelated to education and experience of teachers.[11]

In the view of this author, the appropriate question posed by these studies shoudl be, "Which teacher (or other school personnel) characteristics do local school decision-makers (i.e., the educational managers and technologists) perceive as contributing to school quality?" In the spirit of the argument put forth in Section II, in the absence of some universally accepted notion of educational quality, it is proposed that we rely upon the judgements, as revealed through market behavior, of local school decision-makers regarding which school inputs do or do not contribute to educational quality. It is for this purpose that empirical investigation of the demand and market price schedules for school inputs can lead to some statements about endogeneity (i.e., that is which variables are choice variables for school decision-makers) and hence, can be a guide as to which characteristics should be included (i.e., are exogenous) and which held constant (i.e., are endogenous and thus perceived to contribute to educational quality) in determining the variations in the cost of educational services. In terms of equation (2) we are specifically interested in isolating the impact of variation in the supply factors Z_S on the salaries of school personnel while holding the decision (or endogenous) variables q (personnel quality) and W (the endogenous working conditions) constant. This will provide policy-makers with information on the variation in the cost of a given quality of school

personnel across school districts.[12]/

One difficulty encountered in using the market approach to assess educational quality is the constraint on the allocation of resources in school districts resulting from the limitations on the choice of personnel quality imposed by the tenure laws and seniority provisions in union contracts. In effect the provisions of the tenure laws, while allowing districts to choose the number of teachers to be employed, constrain the choice of which teachers (and therefore which combination of quality characteristics q) will be employed. This results from the fact that tenure laws (or union contracts) specify seniority as the basis for the order of dismissal of school personnel--i.e., those with the least seniority being dismissed first in response to a decline in enrollment or the elimination of educational programs. The quality characteristics of school personnel can therefore only be adjusted at the margins through newly hired staff members. The empirical implication of this constraint is that the level of employment of the constrained characteristics will not vary systematically across districts according to variations in the supply and technology factors and/or differences in district budgets.[13]/ It is of interest to note that this author has reported elsewhere some empirical evidence consistent with the hypothesis that the school decision-makers in a sample of unified districts in California are operating on their lower bound constraints for teacher experience.[14]/ That is, because of the constraints imposed by teacher tenure arrangements on district decision-making, school officials are unable to adjust the level of teacher experience downward to its desired (or optimal) level.[15]/ This observation is particularly true for the many districts currently facing declining enrollments. One implication of these empirical results is that school decision-makers would prefer a higher rate of turnover among teachers which would allow for the replacement of the older, relatively more experienced teachers with the newer and more inexperienced teachers. The higher rate of turnover increases the ability of the district to adjust downward the

average level of experience of a teaching staff with "too much" experience.

One way of dealing with this problem is to focus attention on the determinants of the characteristics of the newly hired teachers across local school districts. An empirical methodology can be developed to estimate the demand equations for newly hired teachers and to determine whether or not particular districts are operating on the constraints imposed by tenure laws.[16]/

A second set of factors which affect the cost of producing a given quality of educational services are technological factors. Conventional wisdom suggests that different kinds and combinations of school inputs will be required to provide a given quality of school services to different kinds of pupils: that is, differences in pupil composition by, for example, socioeconomic background or racial and ethnic characteristics. Specifically, one would suspect that the perceptions of school decision-makers of the relationship between the level of educational quality and the combinations of school inputs will vary systematically according to some relevant set of personal characteristics of the student population and perhaps even with the scale of operation of the school district. For example, most school officials are likely to believe that it will cost more and require different patterns of expenditure to provide a given quality of school services to relatively low socioeconomic pupils. In the jargon of the school finance literature in education, these so called technology factors might more appropriately be referred to as pupil-need factors (excluding, of course, the scale affects referred to above).

This analysis is analogous to the development of cost-of-living indices for families of different composition. It is suggested that both family background and structure will influence preferences and, hence, the relevant weights used in the construction of cost-of-living indices. There is a literature which has suggested both a theoretical and empirical methodology for determining the effect of, for

example, differences in age structure of families on expenditure patterns and, hence, on the cost-of-living.[17] The cost-of-living for older families will differ from the cost-of-living for younger families due to systematic differences in expenditure patterns which are likely to exist.

For school districts these technological factors affecting the costs of services are determined exogenously to school decision-making since, for all intents and purposes, student composition and the number of pupils within the boundaries of school districts are outside the control of school officials. Once again, a dollar's worth of state aid will vary in the quality of educational services it will buy due to the variations in technological factors across school districts, ceteris paribus.

Ideally, it would be useful if a market test could be devised to determine the impact of pupil-need on educational cost. Such a methodology would involve the determination of the extent to which expenditures need to be adjusted to provide different types of pupils (classified according to need characteristics) with a given quality of educational services by examining the behavior of school district decision-makers in the market for school inputs, i.e., through an examination of variations in the patterns of demand for school inputs attributed to variations in the technology factors. If such a methodology could be devised, it would imply that decisions on expenditure adjustments to account for pupil-need need not be carried out through arbitrary weighting structures developed by centralized authority (e.g., as is currently carried out in most states).

It should be noted at this point that some of the same variables that affect the supply factors also affect the technology factors. For example, pupil composition by racial and ethnic background is likely to affect both the supply factors (e.g., through the higher teachers' salaries necessary to compensate for the apparent nonpecuniary disadvantages of teaching in districts with relatively large proportions of minority pupils) and the technology factors (i.e., by altering the per-

ceived combination of school inputs required to produce a given level of educational quality). Despite the overlap in the factors that affect the supply and technology conditions, appropriate specification of the model will allow for identification of the supply and technology factors separately.

IV. Constructing a Cost-of-Education Index

Given the outline in the previous Section of what elements determine the cost-of-educational services, we can now formalize this structure in order to determine precisely how this relates to the construction of a cost index for educational quality. In this discussion we will define what is meant by a "true" cost index as it would apply to school districts and, in the process, illustrate the difficulties in actually constructing such an index based on available information on educational quality and technology.

To draw on the economic theory of index numbers, a "true" cost-of-education index is defined to be the ratio of the minimum expenditure required in two different supply (cost) and/or technology situations (i.e., either comparing two decision-making units--e.g., school districts--at one point in time or one decision-making unit at two points in time) to provide a given quality of educational services. To compare two school districts at a point in time, it is necessary to specify the cost function for a given district. As in equation (2), we designate Z_S as the (exogenous) supply factors and we let Z_T represent the exogenous technology factors (i.e., pupil-need and district scale). Formally, the cost function for the district may be written,

$$E = E(Q, Z_S, Z_T). \qquad (3)$$

This function describes the minimum expenditure (or cost) necessary to produce a given quality (Q) of educational services given the supply and technology situations described by Z_S and Z_T.

Graphically, this cost situation can be illustrated using the standard isoquant-isocost analysis of economic theory. For expository purposes assume that there are only two school inputs x and y (e.g., teachers and teachers' aides). In figure 1 the curve labeled Q* is an isoqual representing the various combinations of x and y necessary to produce the desired level of quality Q*.[18] The further from the origin (0) this curve is situated, the higher

Figure 1 about here

the level of quality represented. The curvature of the isoqual reflects the fact that as we trade-off x for y it requires more and more of y for every unit of x sacrificed to maintain the same level of quality. The isocost curve labeled E* in figure 1 represents the various combinations of x and y that may be purchased for a fixed level of expenditure in the market. The curvature at any point along the isocost curve reflects the rate at which these two inputs can be traded in the market given the factors that determine the supply prices. Based on this analysis, it should be evident that the isoqual reflects the educational technology; and, therefore, the elements of the vector Z_T determine its position and curvature in the (x, y) plane. Similarly, the isocost curve reflects the market supply conditions and therefore the vector Z_S determines its position and curvature in the (x, y) plane. For simplicity the isocost curve has been assumed to be linear.

The equilibrium point in figure 1 occurs at the point corresponding to (x*, y*) where the isoqual and the isocost curve are tangent to one another. This point represents the minimum expenditure necessary to achieve the given level of educational quality. Thus, it corresponds to one point on the cost function (3) where Z_S and Z_T take on the values reflected by the isoqual and isocost curves

in figure 1. It can be seen that (x^*, y^*) is a point of minimum cost for Q^* since any point such as (x', y') requires a larger expenditure corresponding to isocost E' while with an isocost such as E'' we are not capable of achieving quality level Q^*.

Using this analytical framework we are now ready to define the "true" cost index for various supply and technology situations. Consider first two different supply (or cost) situations Z_{Si} and Z_{Sj} facing school districts i and j. It is assumed that the technology conditions are identical for the two districts. In figure 2 the fact that Z_{Si} is steeper than Z_{Sj} reflects the higher relative price of input y in district i. The cost-of-education index C_{ij} between the two

Figure 2 about here

districts is then given by the ratio of E_j to E_i (i.e., $C_{ij} = E_j/E_i$) where E_j and E_i represent the minimum expenditure necessary for both districts to produce a level of educational quality equal to Q^*. As indicated in figure 2 district j uses a relatively higher ratio of input y to x (i.e., y_j^*/x_j^*) than does district i (which employs y_i^*/x_i^*) since district j faces a relatively lower (higher) price for input y (x).

Now consider two districts i and j facing identical supply situations (i.e., $Z_{Si} = Z_{Sj}$) but differing technology situations $Z_{Ti} \neq Z_{Tj}$. Suppose district j had a relatively large proportion of disadvantaged pupils who required different amounts (presumably, relative more) and combinations of school inputs in order to achieve the same quality of educational services as the nondisadvantaged pupils in district i. This suggests that both the curvature and the position of the isoqual will differ for district j. This example is illustrated in figure 3.

In general the isoqual for Q_j^* (where $Q_j^* = Q_i^*$) will be further from the origin

Figure 3 about here

than the isoqual for Q_i^*.[19] The cost index C_{ij} is once again defined as the ratio of E_j to E_i as shown in figure 3 (i.e., $C_{ij} = E_j/E_i$).

Using the conceptual framework set out in figures 1, 2, and 3, one can now demonstrate that our inability to measure educational quality and to identify the technology prevents the construction of the "true" cost index. In the case of different supply situations illustrated in figure 2, economists use a fixed input index rather than the "true" index which is indeterminate without additional information. Figure 4 illustrates the difference between the fixed input and the "true" index. The fixed input index is equal to the ratio of E_j'/E_i, while the true index is E_j/E_i. It can be seen that the difference between the two indices

Figure 4 about here

is that the true index accounts for the fact the school district j is able to substitute the relatively less costly input y in order to produce the quality level Q*. If the relative price that districts have to pay for teachers increases, then those districts will tend to substitute away from teachers toward other school inputs such as teachers' aids. The problem is that the fixed input index does not account for this kind of substitution. The fixed input index ignores the possibility that the same level of quality may be produced at a lower cost (than would be true under the fixed input assumption) by substituting teachers' aids for teachers (or class size). It can be seen that the fixed input index will tend to overstate the degree to which district j's costs of Q* exceed district i's costs of Q*, i.e., $E_j'/E_i > E_j/E_i$. In fact with an expenditure of E_j' district j could

achieve a level of quality Q' if expenditures were reallocated from input x to input y, i.e., from (x_i^*, y_i^*) to (x_j', y_j').

There is a case in which the fixed input and the true index are equal. Suppose the educational technology exhibited fixed proportions. This would imply that the isoquals were L-shaped, and that only a fixed ratio of school inputs could be used to produce educational services. Thus, any additional units of one input, ceteris paribus, would be redundant and would not yield any additional output (or quality in this case). This situation is illustrated in figure 5. Both the fixed input and the true index are defined by the ratio E_j/E_i.

Figure 5 about here

In the case of the different technology situations illustrated in figure 3, it should be clear that even more information is required to be able to identify the true index. Specifically, we need some information about the impact of our technology (i.e., pupil-need) factors upon the quality production function. Despite the difficulties encountered in such an analysis, there is a methodology which has been developed by economists to deal with the issue of differences in family consumption patterns caused by differences in the composition of households by, for example, age structure. The effort in this literature has been toward the development of what are referred to as "household equivalency scales" which essentially permit welfare comparisons of households of different composition facing the same or different prices of consumption goods.[20] Applied to the study of resource allocation in school districts, our efforts would be directed toward the development of "school district equivalency scales" which would permit us to make quality (welfare) comparisons of school districts with varying compositions of

pupils (classified according to need characteristics) and facing the same or different prices of school inputs.

IV. Concluding Remarks

It should be evident from the foregoing analysis that an accurate accounting of the factors that make up a cost-of-education index will require the specification of a comprehensive model of resource allocation in public school districts.[21] It is the lack of such a theoretical framework that essentially invalidates Brazer's (1974) attempt to calculate an educational cost index. His error lies in his failure to appropriately specify which of the determinants of teachers' salaries were endogenous and which were exogenous to school district decision-making. His choice is essentially arbitrary.

In addition it should also be evident that a comprehensive index of the cost of educational services must account for both the variations in the supply factors (i.e., those affecting school input prices) and the technology factors (i.e., the need related characteristics of the pupils and the scale of operation both of which affect the school district's ability to produce educational services). To reiterate, our goal should be to develop a "school district equivalency scale" which reflects the minimum levels of expenditure (per pupil) required for two districts facing differing supply and/or technology (pupil-need) conditions to provide equal levels of educational quality. Moreover, it is to be emphasized that quality as defined in this paper refers to perceived quality. Perceived quality is based on a market test: that is, the relative values of various school inputs and the relative impact of various compositions of pupils on the educational technology are assumed to be reflected by the market behavior of school decision-makers. Teacher (school personnel) characteristics which are valued will exhibit employment levels across districts that vary systematically

with differences in supply, technology, and school budgets and moreover, these valued characteristics will reveal an implicit market price within the context of the market price schedule for teachers (school personnel). Furthermore, it will be observed that pupil characteristics that influence the educational technology will cause systematic variations in the expenditure patterns of school districts.

It is important to note that the local school systems must operate, at least in the long run, on the basis of what is credible to the local community. That is, the evaluation of educational quality carried out by school decision-makers (i.e., their perception of the quality of educational services) must appear believeable to the citizenry. Convention wisdom suggests that inputs are a measure of, or proxy for, educational quality. Therefore, school district decision-makers have been hypothesized to possess an objective function which reflects the apparent contributions of various educational inputs to the quality of educational services. It is up to the decision-makers to convince the community that the districts revealed preferences for these various inputs reflect contributions to educational quality.

At this point this author would like to express a word of warning regarding the proposed market test approach to the assessment of educational quality. Some readers might be tempted to draw the conclusion that by relieving researchers and/or state educational policy-makers from making judgements about what educational quality is, the market test methodology is somehow value free, i.e., the values of researchers and state policy makers are not imposed on the system. However, in all honesty, a value judgement has been made within the context of the market test proposal itself. That is, the advocate (in this case this writer) of the market test is implicitly placing a value on the decentralization of decision-making which is consistent with increased personal freedom and individual choice. In the short run this market approach provides the school decision-makers (who are supposed to represent the preferences of the local constituency) with the power to determine

what school quality is, while in the long run individual families have the option of voting with their feet by moving to communities that exhibit similar preferences regarding assessments of education quality.[22]/

In the limit one would perhaps desire to place this assessment of educational quality directly in the hands of the individual consumer (i.e., families with school age children in this case) so that a more pure form of consumer sovereignty could exist in the market for educational services.[23]/ This approach would obviously require instituting a market for educational services (e.g., through an education voucher system). However, currently it appears that such a system of choice is not politically feasible. Furthermore, this choice alternative is beyond the scope of this paper. Thus, the current system of public education has been taken as given for the purpose of this paper.

In view of the analysis presented in this paper this writer cannot resist making some final comments regarding the inappropriateness of the cost-of-living index currently in use in Florida for the purpose of equalizing the purchasing power of state school aid. Much of the argument over the Florida Price Level Index (FPLI) has focussed on such issues as whether or not it is an accurate measure of the cost-of-living within a given district or whether or not it is the appropriate adjustor of employee salaries who do not live in the district.[24]/ It is the view of this author that much of this discussion is irrelevant to the main issue. To be specific, Simmons (1975) suggests that "It (the FPLI) only assures that the appropriation by the state on a per-pupil basis has equal purchasing power in each county." (p. 120) The issue is purchasing power with respect to what--the market basket of goods purchased by consumers? Clearly, in attempting to provide school districts with equal purchasing power, the relevant market basket is not that which is purchased by the representative consumer but the market basket of school inputs purchased by local school districts. The relevant adjustment in the state aid formula would be one which provided for

equal purchasing power on the part of local school districts in the market for school inputs. The cost-of-living index is but one component in the work-choice decisions which affect the salaries of school personnel and hence the cost of educational services.

FOOTNOTES

[1]This issue of equity has been the thrust of the school finance reforms implied by the decisions of the Courts (e.g., in Serrano vs. Priest, the California equal protection suit).

[2]There have been various proposals for revision of state aid formulas in order to resolve this equity issue. Perhaps the most obvious method would be to equalize expenditures per pupil across all districts. Alternatively, Coons et al. (1970) have suggested Power Equalizing as a mechanism to establish wealth neutrality in school finance formulas. However, Feldstein (1975) has demonstrated that the Power Equalizing formula does not in fact provide for wealth neutrality in school spending and he has proposed an alternative method which he shows does establish wealth neutrality.

[3]In fact separation of E into the elements P and Q is easier said than done. However, for the purpose at hand this formalization is a useful abstraction from the real world which will enable us to reveal the nature of the variation in educational expenditures.

[4]For discussion of this model see Barro (1974).

[5]In the subsequent discussion, some difficulties regarding the interpretation of the market test approach are discussed: specifically, the implications of teacher tenure arrangements with regard to discretionary choice of teacher quality by school decision-makers.

[6]For example, see Reischauer and Hartman (1973), pp. 67-72, for a discussion

[7]One perhaps should use a measure of permanent income or real wealth of individual families in the district which is the usual rationalization for the use of property value as a measure of fiscal capacity. However, as Reishauer and Hartman point out, property value is not a measure of family wealth. It is the equity component of property value that makes up one element of family wealth and the ratio of equity to property value varies systematically across local

communities according to various family characteristics. Moreover, property values is also made up of business as well as residential property, relative values of which also vary across districts. Finally, as Reischauer and Hartman indicate, variations in property value are much more widely dispersed than variation in family income--in some cases the variation is much as 10,000 to one and within the narrow confines of certain metropolitan areas one can fine variation as much as fifteen to one (see p. 67).

[8]See Chambers (1975).

[9]State grants are largely based on assessed value of property in the district: the greater the assessed valuation of property, the smaller, in general, will be the state aid. To the extent that property in the district is residential, districts with relatively high assessed valuation of property are generally higher income districts. This result simply reflects the fact that higher income families exhibit a greater demand for housing services. Moreover, both the state and federal governments provide categorical aid of which a substantial portion is directed toward improving educational opportunities for relatively disadvantaged children. Based on these considerations, one would expect higher income communities to be receiving a lower level of state and federal grants-in-aid than lower income communities.

[10]The studies included in this category are Wasserman (1963) and the studies discussed in some detail by Wasserman, pp. 110-121. These studies include "The National Educational Association Index of 1938,""Price Indexes Compiled by Lorne H. Woollatt," and "Indexes Compiled by New York State Education Department."

[11]See Wasserman, pp. 110-127 for a complete discussion.

[12]Variations in the prices of other school inputs are probably a less significant source of educational cost variation due to the fact that they compose only a relatively small fraction of the educational budget. Nevertheless, in order to capture educational cost variations across districts, one must account

for differences in the prices of such components of the budget as instructional materials, construction costs, land prices, and interest charges.

[13]For a complete specification of the model and a detailed discussion of these constraints of tenure on the choice of personnel quality see Chambers (1975).

[14]See Chambers (1975).

[15]The word optimal in this context refers again to this concept of perceived quality. Therefore, teacher experience in these districts is above its perceived optimal (or desired) level.

[16]The methodology essentially involves the estimation of the demand equations for the quality characteristics of newly hired teachers taking into account the fact that the quality characteristics are "limited (i.e., constrained) dependent variables." For a discussion of the estimation procedures see, for example, Nelson (1975).

[17]See Meullbauer (1974) for a theoretical discussion and Parks and Barten (1973) for an empirical application of household composition effects on consumption patterns.

[18]This curve is so named because the prefix iso- means equal or identical. Thus, isoqual refers to equal levels of quality along the curve. Similarly, we can define the term isocost which refers to equal levels of cost along a curve described below in the text.

[19]Note that Q^* corresponds to technology vector Z_{Tj} and Q_i^* corresponds to technology vector Z_{Ti} ($\neq Z_{Tj}$).

[20]See Muellbauer (1974) for a detailed discussion.

[21]For a detailed discussion of the factors that compose such a model the reader is referred to Chambers (1975).

[22]Of course, this option of moving is not open to all families on an equal basis. Low income and/or discrimination in housing patterns will tend to reduce and perhaps effectively eliminate this option for some families.

[23]Of course, a certain amount of state intervention would perhaps be warranted in order to ensure the citizenry that there would be no change in the nature and flow of external benefits of education to the society at large.

[24]For an exchange between two authors on these issue the reader is referred to Fox (1975) and Simmons (1975).

REFERENCES

Averch, Harvey A., Carroll, Stephen J., Donaldson, Theodore S., Kiesling, Herbert, Pincus, John. How Effective is Schooling? A Critical Review and Synthesis of Research Findings. Rand Corp. (R-956-PCSF/RC), January 1972, Santa Monica.

Antos, Joseph R. and Sherwin Rosen. "Discrimination in the Market for Public School teachers," BLS Working Paper No. 24 (September 1974).

Barro, Stephen M. "The Impact of Intergovernmental Aid on Public School Spending," unpublished Ph.D. dissertation, Department of Economics, Stanford University, 1974.

Barten, A.P. "Family Composition, Prices and Expenditure Patterns," in Colston Papers, 16 (1964), 277-292.

Brazer, Harvey E. "Adjusting for Differences Among School Districts in the Costs of Educational Inputs: A Feasibility Report" in Selected Papers in School Finance 1974, U.S. Department of Health, Education, and Welfare; Office of Education.

Chambers, Jay G. "The Impact of Collective Negotiations for Teachers on Resource Allocation in Public School Districts" an unpublished Ph.D. dissertation, Department of Economics, Stanford University, 1975.

Coons, J.E., W.H. Clune III, and S.D. Sugarman, Private Wealth and Public Education, Belknap Press (1970).

Feldstein, M.S. "Wealth Neutrality and Local Choice in Public Education," American Economic Review, LXV: 1 (March 1975), p. 75-89.

Fisher, F.M. and K. Shell. "Taste and Quality Change in the Pure Theory of the True Cost of Living Index," in Z. Griliches, Ed. Price Indexes and Quality Change: Studies in New Methods of Measurement, Cambridge, Mass., 1971.

Fox, James N. "Cost-of-Living Adjustments: Right Intent, Wrong Technique" Phi Delta Kappan, LVI: 8 (April 1975), p. 548-550.

Griliches, Zvi. "Hedonic Price Indexes Revisiting" in his Price Indexes and Quality Change: Studies in New Methods of Measurement, Cambridge, Mass., 1971.

Griliches, Zvi. "Hedonic Price Index for Automobiles: An Econometric Analysis of Quality Change," in his Price Indexes and Quality Change: Studies in New Methods of Measurement, Cambridge, Mass., 1971.

Grubb, Norton W. "A Proposal for Analyzing the Impact of Teacher Price Differences". Unpublished proposal written at the Childhood and Government Project, University of California, Berkeley.

Hanushek, Eric. "The Value of Teachings in Teaching," The Rand Corporation (December 1970).

Houthakker, H.S. "Compensated Changes in Quantities and Qualities Consumed," Review of Economic Studies, 19 (1952), 155-164.

Katzman, Martin T. The Political Economy of Urban Schools. Cambridge, Mass.: Harvard University Press, 1971.

Kiesling, Herbert J. "Multivariate Analysis of Schools and Educational Policy". The Rand Corporation (March 1971).

Levin, Henry M. "Recruiting Teachers for Large City Schools" an unpublished monograph. Brookings Institution (June 1968).

Muellbauer, John. "Household Composition, Engel Curves and Welfare Comparisons Between Households", European Economic Review, 5 (1974), pp. 103-122.

Muellbauer, John. "The cost of Living and Taste and Quality Change", Journal of Economic Theory, 10, (1975), pp. 269-283.

Nelson, Forrest Duane. "Estimation of Economic Relationships with Censored, Truncated and Limited Dependent Variables" Ph.D. Dissertation, Department of Economics, University of Rochester (1975).

Parks, R.W. and A.P. Barten. "A Cross-Country Comparison of the Effects of Prices, Income and Population Composition on Consumption Patterns", Economic Journal, 83 (September 1973), pp. 834-852.

Reischauer, Robert D. and Robert W. Hartman. Reforming School Finance, The Brookings Institution, Washington, D.C. (1973).

Rosen, Sherwin. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition", Journal of Political Economy, 82: 1 (January/February 1974), pp. 34-55.

Samuelson, Paul A. Foundations of Economic Analysis, Cambridge, Mass.: Harvard University Press, 1947, pp. 146-163.

Simmons, James C. "Comments on 'Cost-of-Living Adjustments in School Finance" Phi Delta Kappan, 57: 2 (October 1975), p. 120.

Toder, Eric Jay. The Distribution of Public School Teachers by Race and Income Class in an Urban Metropolitan Area. Medford, Mass.: Tufts University, (March 1971). Report to U.S. Dept. of H.E.W. Office of Education: Bureau of Research.

United States Department of Labor, Bureau of Labor Statistics, The Consumer Price Index: History and Techniques, Bulletin No. 1517.

Wasserman, William. Education Price and Quantity Indexes. Syracuse University Press (1963).

TABLE I

THE DIFFERENTIALS IN EDUCATIONAL EXPENDITURES PER PUPIL, SALARIES OF SCHOOL PERSONNEL, AND INPUT DEMAND BETWEEN TWO COMMUNITIES WITH AN INCOME DIFFERENTIAL OF $4,000 PER HOUSEHOLD[a]

Dependent Variables (1)	Elementary School Districts		
	Differentials Due To:		
	Difference in Community Income (2)	Difference in Grants-in-Aid Per Pupil (3)	Net Difference (2) + (3) = (4)
Expend./Pupil	252	-60	192
Starting Tchr. Sal.	230	-45	185
Sal. Incre. for Tchr. Exp.	23	- 5	18
Av. Prin. Sal.	865	-168	697
Av. Supt. Sal.	581	-113	468
Av. Class Size	-1.58	0.30	-1.28
Av. Yrs. Tchr. Exp.	0.85	-0.17	0.68
Av. Grad. Credit Hrs. Per Tchr.	4.25	-0.83	3.42

[a]Empirical estimates indicate that for each additional $1,000 of income per household, the average elementary district gives up $18.02 in state and federal grants per pupil. The $4,000 income differential hypothesized above leads to a reduction in grants per pupil of $72.08 (=4 x 18.02) for this sample of elementary districts.

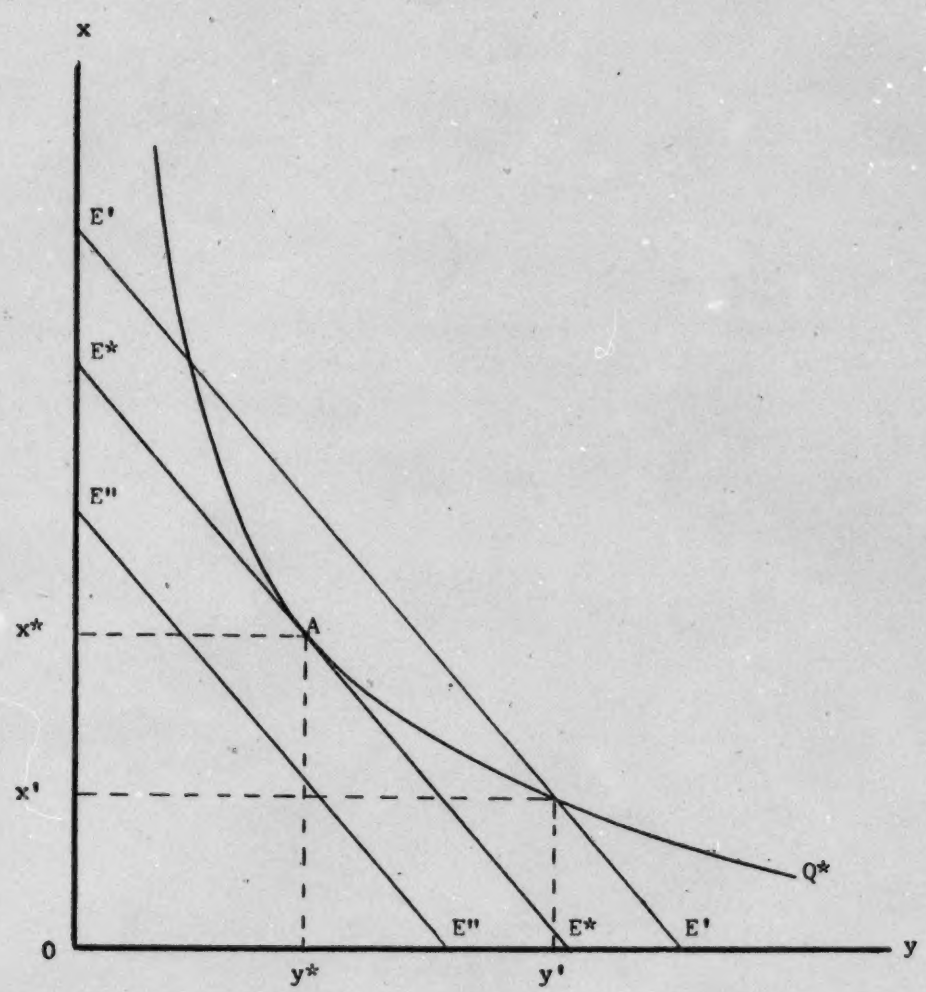

FIGURE 1

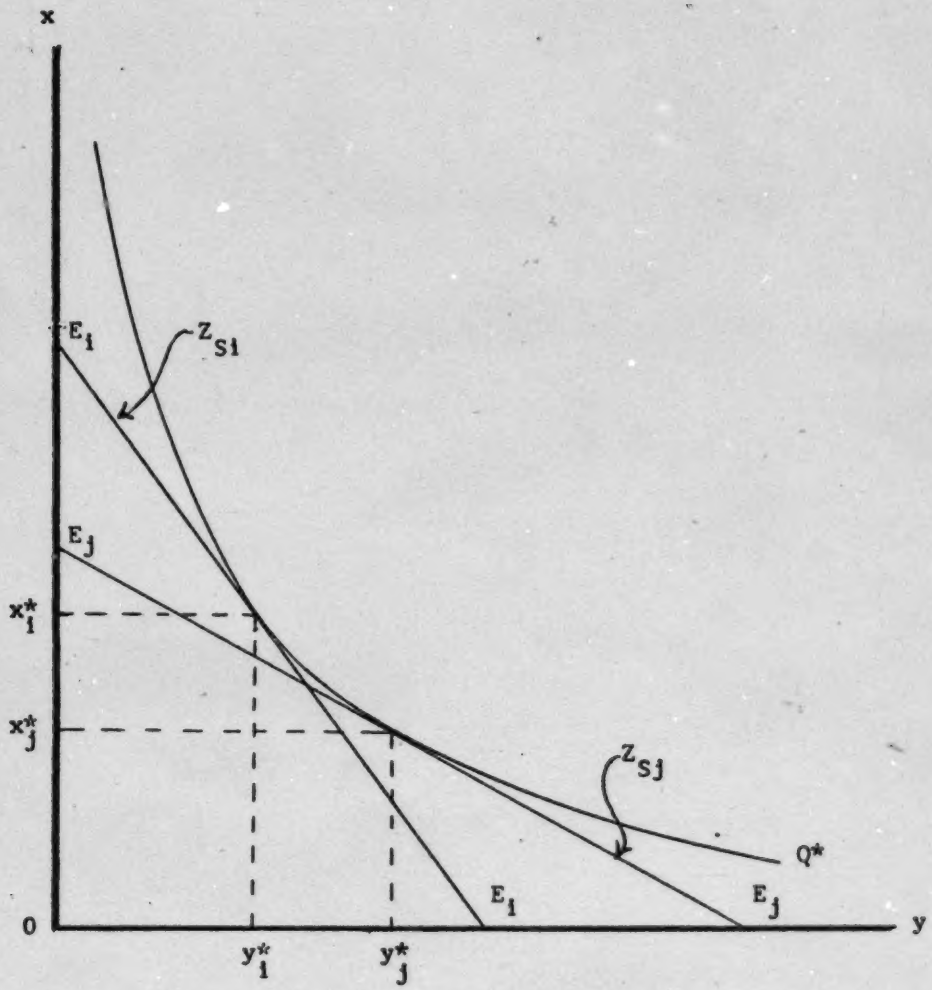

FIGURE 2

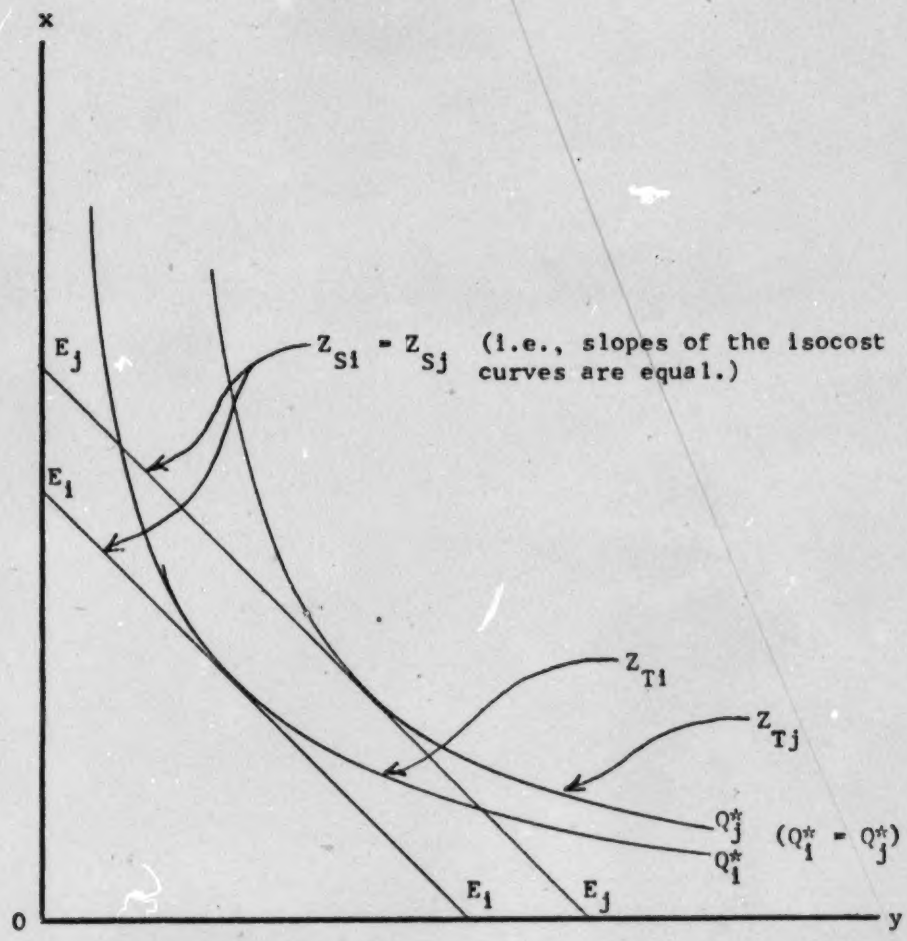
x
E_j
$Z_{Si} = Z_{Sj}$ (i.e., slopes of the isocost curves are equal.)
E_i
Z_{Ti}
Z_{Tj}
Q_j^*
$(Q_i^* = Q_j^*)$
Q_i^*
E_i
E_j
0
y

FIGURE 3

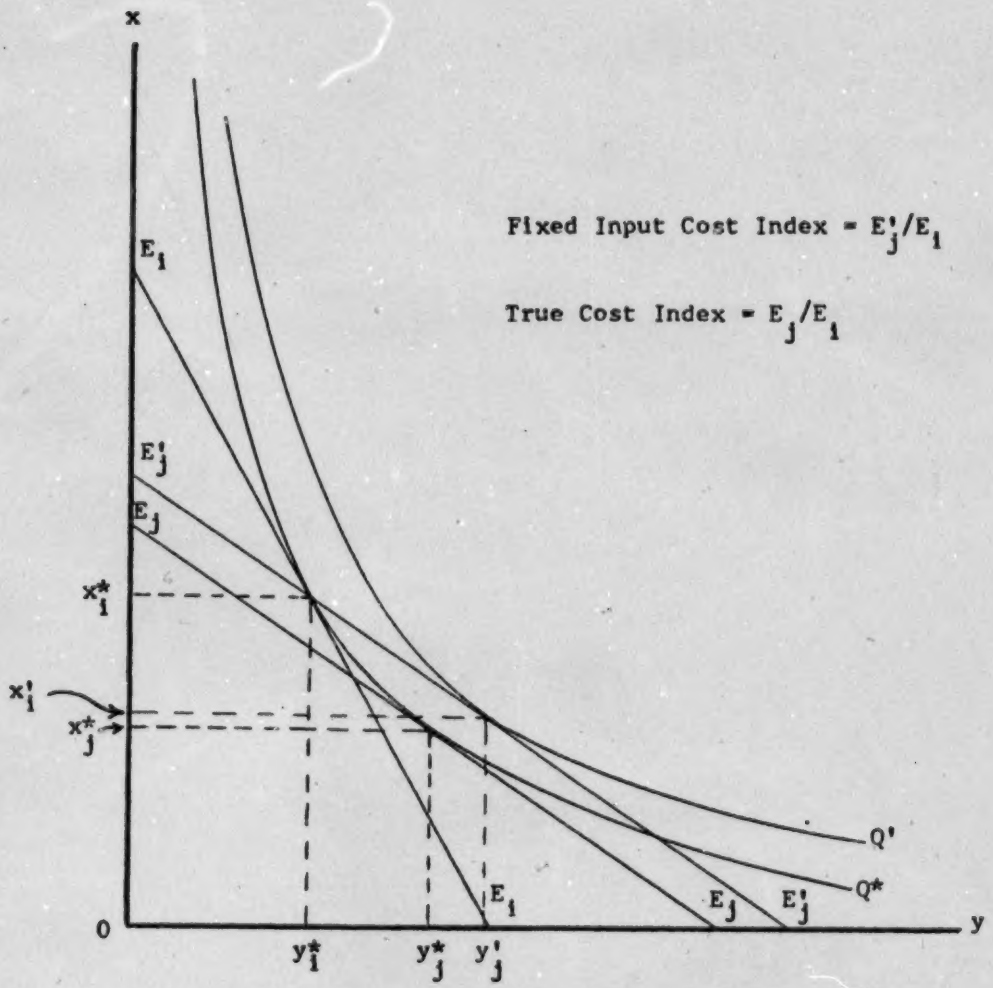
x
y
0
Fixed Input Cost Index = E'_j/E_i
True Cost Index = E_j/E_i
E_i
E'_j
E_j
x^*_i
x'_i
x^*_j
Q'
Q^*
E_i
E_j
E'_j
y^*_i
y^*_j
y'_j

FIGURE 4

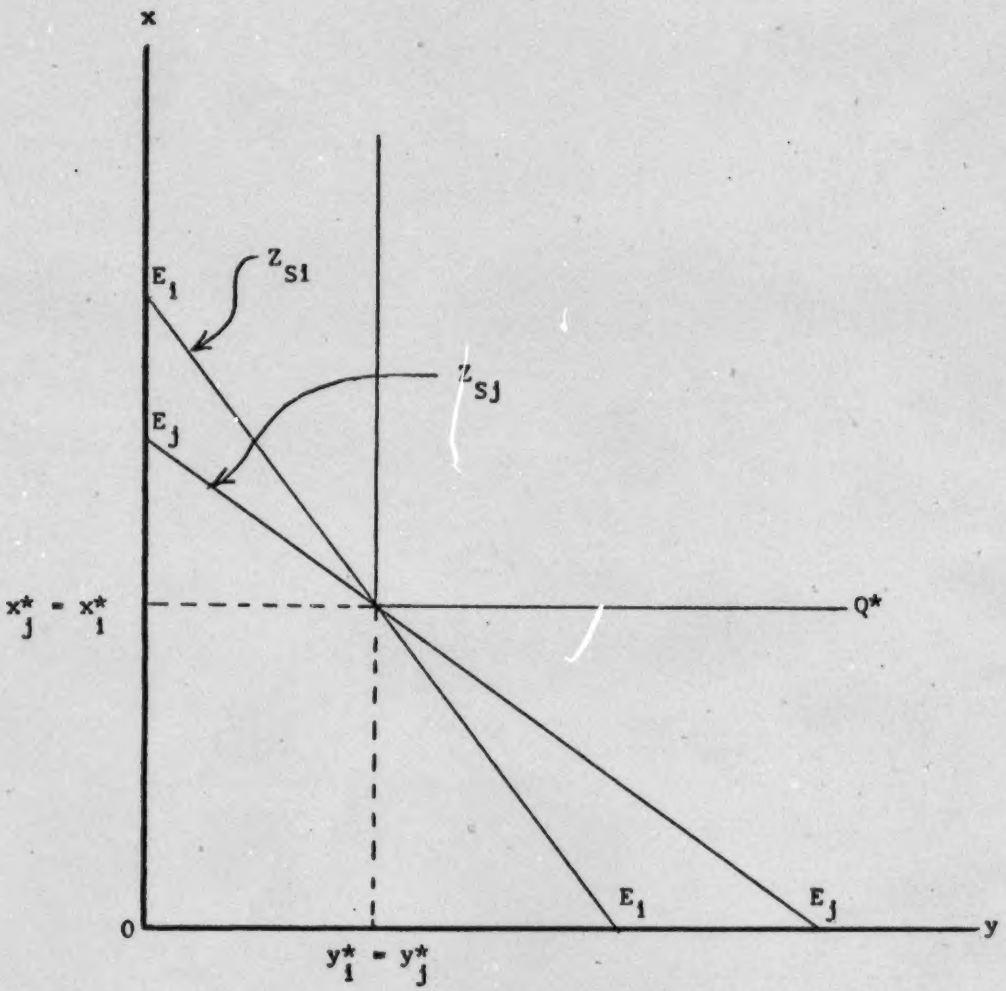

FIGURE 5